National Aeronautics and Space Administration

The **HEASARC**
is NASA's
high energy archive.

One-stop shopping*
for data from **x-ray** and
gamma-ray
space observatories.

A Quick Guide to the HEASARC: NASA's High Energy Astrophysics Science Archive

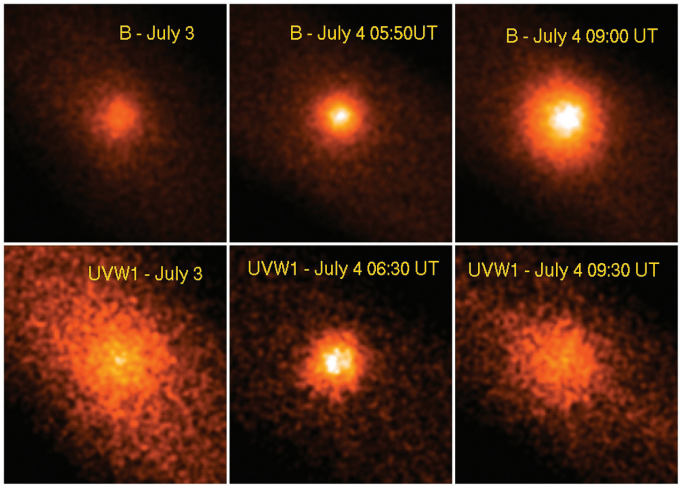
Where can high-energy data take you?

High-energy observational data are central to the study of the some of the most interesting phenomena in modern astrophysics:

- The physics of warped spacetime near black holes and neutron stars can be explored using X-ray and gamma-ray observations
- X-ray images of clusters of galaxies map their structure and evolution
- The interstellar medium from the entire Milky Way Galaxy can be probed using gamma rays
- X rays and gammas ray from supernovae, interacting binaries, AGN, protostars, high- and low-mass stars, brown dwarfs, planets and comets reveal key physical aspects for all these types of objects

The HEASARC – The High Energy Astrophysics Science Archive Research Center – is NASA's prime archive of cosmic data in the extreme-UV, X-ray and gamma-ray bands. We use existing standards to make data available from over 20 past and current high-energy missions, including ROSAT, ASCA, CGRO, RXTE, XMM-Newton, Chandra, Integral, Swift and, soon, Suzaku. This brochure describes services and resources available at the HEASARC.

The HEASARC mission is to support the entire astronomical community, not just X-ray and gamma-ray specialists. HEASARC archival services, Web tools, software, and personnel are all dedicated to supporting the broadest use of high-energy astronomy data.



XMM-Newton Detects Water on Tempel 1 During Deep Impact
Images taken by the Optical Monitor on board ESA's XMM-Newton observatory on 3 and 4 July 2005 contrast the states of the comet before and just after impact. The ultraviolet images show the emissions of hydroxyl ions, the direct decay product of water.
Rita Schulz, ESA-ESTEC

***data, software, and documentation are freely available over the internet at http://heasarc.gsfc.nasa.gov**

www.nasa.gov

How Do I...?

...Convert X-ray flux/energy/count rate units to those used in my field?

Our WebPIMMS tool can convert from instrumental units, such as count rates, to physical units, such as fluxes, and vice versa.

HEASARC home page > Tools > WebPIMMS

A general energy converter also helps translate energy units.

HEASARC home page > Tools > Energy Converter

...Find out which X-ray satellites have looked at my favorite object?

You can use Browse to search the observation catalogs of individual, several or all satellites which have X-ray instruments.

HEASARC home page > Archive

...Quickly get the X-ray, gamma-Ray or EUV count rate for my favorite object?

Use the HEASARC tool `Is My Favorite Object an X-Ray, Gamma-Ray, or EUV Source?' to search for measurements listed in the appropriate HEASARC master catalog.

HEASARC home page > Tools > Source Finder

...Find and download data from the HEASARC?

The HEASARC's Browse service helps you find data by specific astronomical criteria and will help you create a tar file of interesting data.

HEASARC home page > Archive

If you already know the structure of our archive and name of the dataset that you want, you can get also get the data directly from the anonymous ftp area.

HEASARC home page > Archive > FTP (link in left column)

...Do something useful with these files containing 'event lists'?

High-energy instruments often count individual photon 'events'. To create the maps, spectra or time-series with which you may be more familiar, use XSELECT.

HEASARC home page > Software > XSELECT

...Analyze data?

The HEASARC's portable XANADU package supports spectral, temporal and spatial analysis of high-energy data. You can use this immediately on the high-level standard products in the HEASARC archive

HEASARC home page > Software > XANADU

FTOOLS provide more discrete analysis tools including mission specific analysis pipelines.

HEASARC home page > Software > FTOOLS

The HEASARC has also recently developed a new service called Hera which permits users to analyze data over the Internet without having to download and install software on their own computers.

HEASARC home page > Software > Hera

...Figure out which satellite can do the science I'm interested in?

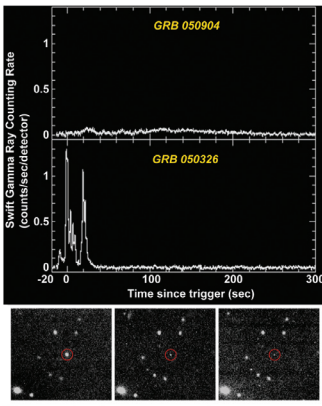
The HEASARC has extensive documentation for high-energy astronomy missions

HEASARC home page > Observatories

including a number of tables which compare instrumental capabilities, e.g.

HEASARC home page > Observatories > Comparison.... (link in "Other Resources" box)

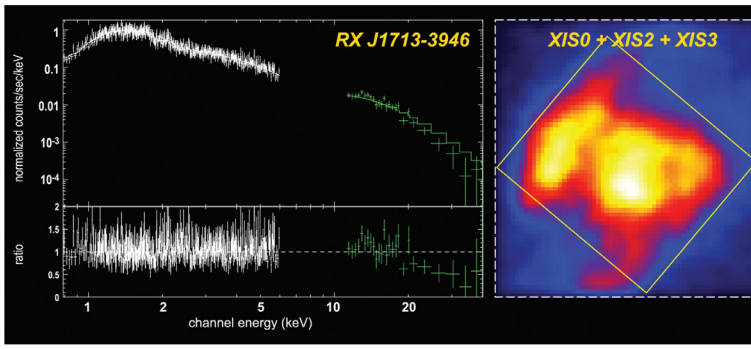
Swift Detects Most L



The emission comes from an era s first formed, about 500 million to 1 Bang.

NASA/PSU/Swift team

Suzaku Observes Non-Thermal Emission from a Supernova Remnant



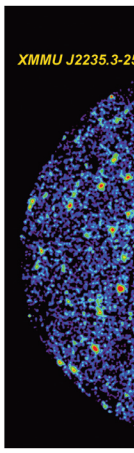
Suzaku observed the bright Eastern rim of the supernova remnant RX J1713-394 The XIS image (18'x18') is shown with the extraction region for the XIS spectrum A hard power-law spectrum is seen with the XIS and the HXD/PIN. The small (34 FOV of the HXD/PIN was essential for this observation, given the location of this supernova remnant in the crowded region on the Galactic plane.

ISAS/JAXA and the Suzaku team

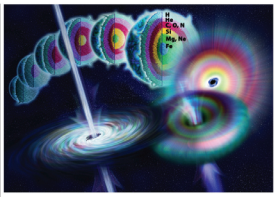
XMM-Newton's Surpris Developed Structure in

By combining observations with ESO's Very Large Telescope and ESA's XMM-Newton X-ray observatory, astronomers have discovered the most distant, very massive structure in the Universe known so far.

Christopher Mullis, University of Michigan



Distant Explosion



On September 4, 2005, Swift detected a powerful Gamma-Ray Burst (GRB 050904) which lasted for more than 200 seconds. At a redshift of 6.29, the burst is located at a distance of about 13 billion light years. soon after stars and galaxies 1 billion years after the Big

…Find an image, graphic or movie of my favorite object?

The HEASARC has various imagery resources, including an Image Archive and a Video Archive,

HEASARC home page > Education & Public Info > Images & Videos

as well as the HEASARC Picture of the Week and hosting the Astronomy Picture of the Day (both displayed on the HEASARC home page).

...Find teaching resources for my K-12 or college course?

The HEASARC's outreach programs provide many free educational resources for all educational levels and for the general public.

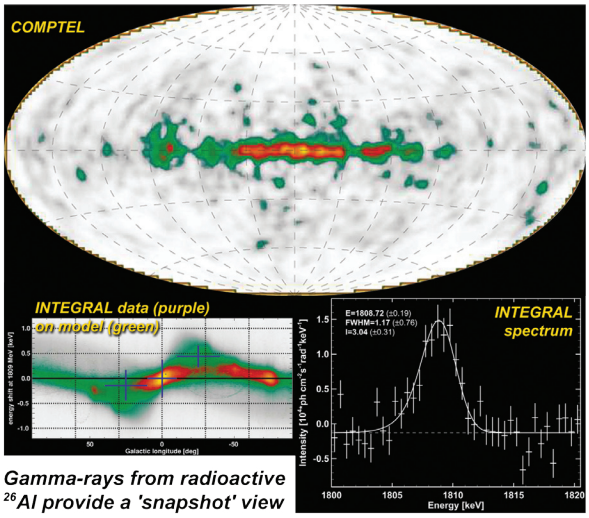
HEASARC home page > Education & Public Info

StarChild and Imagine the Universe! are among the most popular of our E&PO sites:

HEASARC home page > Education & Public Info > StarChild (K-8)
HEASARC home page > Education & Public Info > Imagine the Universe! (high school and the general public).

Most of these "How Do I...?" items are also accessible via the Quick Links menu in the top right corner of every HEASARC page. The list of Quick Links is organized similarly to the HEASARC website itself, separating items into *Archive, Software & Tools, Resources,* and *Education* sections.

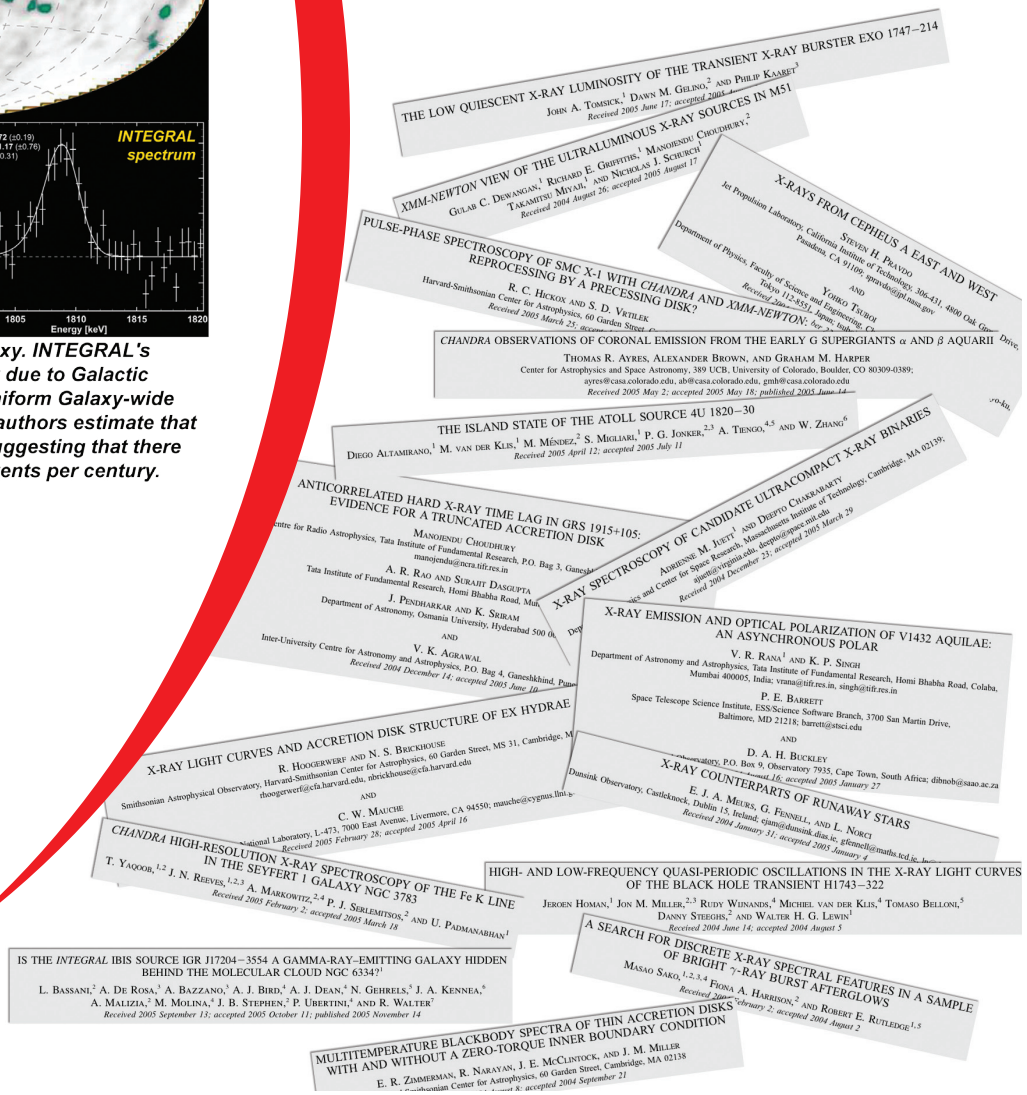
INTEGRAL Maps ^{26}Al in the Galaxy



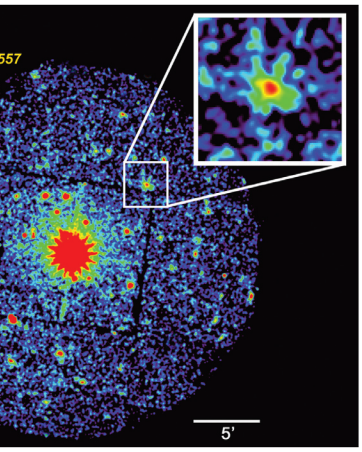
Gamma-rays from radioactive ^{26}Al provide a 'snapshot' view of ongoing nucleosynthesis in the Galaxy. INTEGRAL's observations of the shifting line energy due to Galactic rotation strongly supports a roughly uniform Galaxy-wide origin. From these measurements, the authors estimate that the Galaxy contains about 3$M_\odot$ of ^{26}Al suggesting that there are about 2 core collapse supernova events per century.

R. Diehl, Max Planck Institute

A few places you can find HEASARC data....



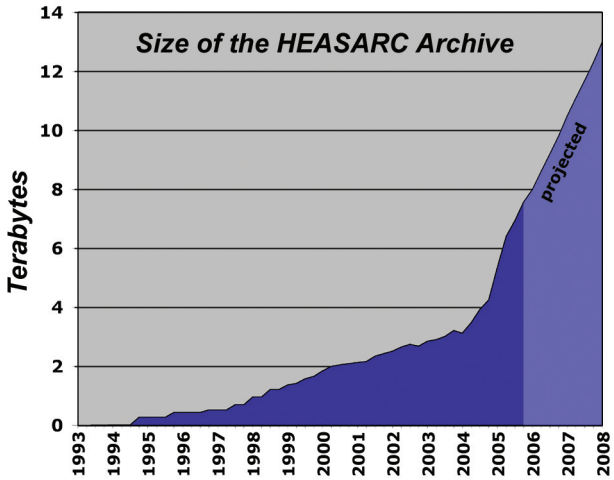
e Discovery of Highly the Young Universe



HEASARC Overview

The HEASARC was established in November 1990 at NASA's Goddard Space Flight Center (GSFC) with a charter to support high-energy astronomy in all phases of research: data browsing, proposal writing, observing, analysis, and data correlation. In 1999, the Harvard-Smithsonian Center for Astrophysics partnered with GSFC in operating the HEASARC.

Since its inception, the HEASARC has taken a multi-mission approach, the same software tools and interfaces being used for different missions. The HEASARC archive is open to all researchers and to the public, and contained, as of January 2006, about 8 Terabytes (TB) of high-energy astrophysics data. New data is being added to the archive at a rate of about 200 Gigabytes each month, and this rate will increase as new high-energy missions, such as GLAST, become operational.



Key HEASARC Services

Browse **http://heasarc.gsfc.nasa.gov/W3Browse/**

Browse is the primary method to access the catalogs, observing logs and data archives of the HEASARC. Browse comprises an easy-to-use, but powerful, web interface to the archived high-energy data. It allows the user to select missions and targets, based on coordinates, object name, or other parameter values. Users can preview and retrieve data from archived observations. Data can also be cross-correlated with many astronomical catalogs.

SkyView **http://skyview.gsfc.nasa.gov/**

SkyView is a 'Virtual Observatory on the Web' and was named by Scientific American as one of the Top 50 Science and Technology Web sites in two successive years (2002 and 2003). Users can use SkyView to generate images of any portion of the sky at any desired scale and orientation, in energy bands ranging from the radio to gamma-ray. SkyView handles any geometric transformations required, allowing the user to concentrate on astronomy.

Software **http://heasarc.gsfc.nasa.gov/docs/software/**

Most HEASARC-supported software is designed for the use of professional astronomers in their analysis of high-energy and other astronomical observations. The software uses FITS-format files which conform to standards developed by the HEASARC for high-energy datasets. There are also some HEASARC programs, such as fv (an interactive editor and viewer for FITS files), which are suitable for more general users.

HEASARC software includes the HEAsoft package which provides a complete and portable analysis environment. HEAsoft is comprised of FTOOLS, a collection of general FITS file utility programs (used to create, examine, or modify the contents of FITS data files) and mission-specific (e.g., ASCA, CGRO, ROSAT, RXTE, Swift) data analysis tools, and XANADU, a set of high-level, multi-mission tasks for X-ray spectral (XSPEC), timing (XRONOS), and imaging (XIMAGE) data analysis.

NVO DataScope **http://heasarc.gsfc.nasa.gov/vo/**

The National Virtual Observatory (NVO) DataScope service uses new VO standards to allow users to query catalogs and archives located at dozens of astronomical sites around the world, and to retrieve information in consistent and comprehensible formats. Current archives which can be queried using this service include NOAO, NRAO, ESO, STScI and SDSS (along with the HEASARC's own resources).

Web Tools **http://heasarc.gsfc.nasa.gov/docs/tools.html**

The HEASARC provides astronomical tools which aid users in planning for high-energy astrophysics observations and in simulating the expected data. These tools allow a user to:

- convert times to and from calendar dates, Julian Days, and Swift and RXTE mission elapsed times (using xTime);
- find the coordinates of the object in many different systems (using the Coordinate Converter tool);
- discover when that object is visible to a particular satellite (using the Viewing tool);
- find the neutral hydrogen column density for that area of the sky (using the nH tool);
- determine the soft X-ray background in that direction (using the X-Ray Background tool);
- find out whether the source has previously been detected at high energies (using the High-Energy Source Finder tool);
- find the estimated count rate or flux for that object based on the previous observations (using WebPIMMS);
- simulate a spectrum of the source (using WebSpec).

RPS **http://heasarc.gsfc.nasa.gov/RPS/**

The Remote Proposal System (RPS) allows users to propose for observations with different high-energy astronomy observatories using either a simple web-based interface or via e-mail.